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# The 'Jalpama' Board Game Based on Pranata Mangsa Ethnoscience: a Solution to Optimize Students' Science Literacy

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**Abstract**

*Purpose*: This study aims to develop IPAS learning media in the form of a board game oriented towards contextual science concepts based on local wisdom and analyze the feasibility of the Jalpama board game media ethnoscience-based Pranata Mangsa to optimize science literacy of elementary school students.
*Methodology:* The method used in this research is R&D through the ADDIE model and is limited to the media development stage. Data will be collected using interviews, documentation, and questionnaires using validation sheets. Data analysis techniques used qualitative and quantitative methods.
*Results:* This research has the results of an ethnoscience-based board game media product called JALPAMA (Jejak Alam Pranata Mangsa), which includes natural resource preservation material as climate change mitigation by containing several game components, namely the game board, companion cards containing contextual information and questions about seasonal changes, natural resources and climate change, as well as supporting devices in the form of instructions for use, pawns, and dice. Based on the media feasibility test results, a percentage score of 91% was obtained, so the criteria for the JALPAMA board game media were said to be "very worthy." Meanwhile, the material expert obtained a percentage score calculation of 96.25%, so the JALPAMA media criteria were declared "very worthy."
*Applications/Originality/Value*: The ethnoscience-based board game Pranata Mangsa uniquely employs local wisdom from Surakarta to enhance science literacy as IPAS learning media. Inspired by Monopoly, it features an engaging format with companion cards, while its distinct point system offers enjoyable motivation for students in their science learning.

## Introduction Section

Education is all aspects that help grow, change, and develop the condition of every human being, both in terms of knowledge, skills, and character in their lives (Pristiwanti et al., 2022). Kadi & Awwaliyah (2017) emphasize that education should be prepared to adapt to the evolving challenges of the times, making innovation essential. The development of technology and science requires stu-dents to have science literacy to understand environmental, health, economic, and other issues (Situmorang, 2016). Science literacy necessitates that students possess a scientific mindset and comprehension of the scientific method, which significantly fosters the Sustainable Development Goals (SDGs) (Queiruga-Dios et al., 2020). This explains why scientific literacy is essential in the 21st century (Indana et al., 2018). The development of scientific literacy is the central pillar of improving the quality of human resources for competitiveness in the era of glob-alization (E. Wahyu et al., 2016). According to the OECD (2023a), science litera-cy is the ability to engage with science issues and to be reflective citizens. People with science literacy can explain scientific phenomena, design investigations, and interpret data scientifically. Science literacy helps Indonesia's young genera-tion build prosperity now and in the future (Hidayati & Julianto, 2018). Strength-ening academic understanding and open-mindedness should be central to culti-vating science literacy, and science practices are also needed in the learning pro-cess in education (Sharon & Baram-Tsabari, 2020). The provision of science literacy in the academic field of Indonesian education can be integrated through IPAS subjects.

However, in reality, Indonesia has a low quality of education compared to 12 other Asian countries. According to The Political and Economic Risk Consul-tancy (PERC) report in Tamam (2023), Indonesia is one level lower than Vietnam. In PISA 2022, Indonesian students' science literacy ranked 68 out of 81 countries with a 383 score below the OECD average (OECD, 2023b). One of the causes of low science literacy is the need for more precise and comprehensive teaching of science literacy contexts in IPAS learning, as well as poorly under-stood real-world applications (Hanifah, 2017).

To overcome this problem, developing learning with a contextual approach and using appropriate media to optimize students' science literacy is necessary. One of the contextual approaches that can improve science literacy in science learning in the 21st century is the ethnoscience approach (Pertiwi & Rusyda Fir-dausi, 2019). The ethnoscience approach

facilitates the identification of content in everyday life (Y. Wahyu, 2017). Pranata Mangsa, rooted in cultural science and local wisdom, directs the division of a year into periods according to the sun's movement (R. D. Handayani et al., 2023). Pranata Mangsa has smaller units that are aligned with the agricultural season, which is divided into four in a year: mangsa ketiga, mangsa labuh, mangsa rendheng, and mangsa mareng. Pranata Mangsa teaches humans to relate better with their climate and environ-ment. This ethnoscience-based IPAS learning design requires innovation and creativity of educators to help students hone their science literacy (Sulhelayati, Z et al., 2023). The ethnoscience approach in IPAS learning can utilize learning media as a learning support innovation. Learning media that integrates the ethno-science approach with local wisdom has proven to receive a positive response and is greatly needed by both students and teachers, as well as being capable of improving learning outcomes (Suwarti et al., 2020). Learning media has various benefits, one of which is that it can present an interactive learning process and interest students (S Karo-Karo & Rohani, 2018). One learning media proven to improve science literacy is board games (H. Handayani & Somantri, 2023; Idhayana et al., 2023). This is supported by previous research with magic spin board media by Idhayana et al., (2023) which showed an increase in science lit-eracy by 11.56% after utilising the media. which showed an increase in science literacy of 11.56% after utilising the media. However, Astini et al., (2023) found that learning media in the form of scientific educational games that are in accord-ance with science concepts are only 28% and categorized as low. Through the integration of ethnoscience learning into board game learning media, it is ex-pected that students can be motivated to learn science contextually and hone their science literacy skills with fun media.

Based on the explanation above, researchers developed an ethnoscience-based board game called JALPAMA (Jejak Alam Pranata Mangsa) or in English trans-lates to Pranata Mangsa Nature Trail. This media studies seasons, weather, cli-mate change mitigation, and natural resource conservation in IPAS learning. The JALPAMA board game presents an attractive game board, innovative learning materials, cards that require players to think critically, and game patterns by col-lecting points. JALPAMA media is expected to make students active in social participation, challenged in learning IPAS, and have a fun learning experience to optimize science literacy. According to Limantara, D. et al., (2015), board games have advantages such as honing social interaction skills and educating students interactively. Students will recognize local wisdom regarding natural resources and climate change mitigation through this board game. This media development aims to make IPAS learning more interesting, fun, and interactive, thereby in-creasing student motivation, interest, and understanding and optimizing science literacy.

## Research Methods

This study used the Research and Development (R&D) method to research, de-sign, develop, and test products to ensure their validity and quality (Rustamana et al., 2024). The Analyze, Design, Development, Implementation, Evaluation (ADDIE) model was used, but this research was limited to the development stage. The ADDIE model is viewed as more logical and thorough, making it appropriate for different kinds of product development (Junaedi, 2019; Mulyatiningsih dalam Rohaeni, 2020). The ADDIE model has been shown to develop media with good validity and to improve student understanding (Anugrahini, 2018). This research aims to develop an efficient, flexible, complete, and rational board game media to optimize science literacy by integrating ethnoscience-based IPAS learning of Pranata Mangsa.

The stages of the ADDIE model in this study include: (1) Analyze: analyzing product needs, performance, students, facts, concepts, principles, procedures of learning materials, and learning objectives. This phase involves recognizing pos-sible issues in the field by conducting observations, interviews, and surveys con-cerning the needs of teachers and students related to science literacy and IPAS learning media (Cahyadi, 2019); (2) Design: crafting the product idea and written content using insights derived from the analysis and developing a storyboard as a plan for product development, drawing on current research references to enhance scientific literacy (Rusmayana, 2021); (3) Development: producing and selecting the best products to develop media ready to be implemented by improving and evaluating existing products and adding innovations. Canva is an application that is used to design board game media with attractive image and text elements. Fur-thermore, experts test and validate the product to determine its feasibility level and become a reference for improvement (Rachma et al., 2023).

Data collection in this study was conducted through interviews, documenta-tion, and product validation. Interviews were conducted with teachers and stu-dents to collect problems and needs related to learning media. Product validation was carried out with media experts, MA, who have expertise in learning media and AD material experts, who have expertise in science learning. Instruments prepared for media and material experts will test aspects of the use and appear-ance of the media and aspects of the material on the media to optimize science literacy. Documentation in data collection to develop board game media products Jejak Alam Pranata Mangsa (JALPAMA) based on ethnoscience Pranata Mang-sa. Product validation analysis was carried out by analyzing the validation results from experts. Data were analyzed qualitatively and quantitatively, using a Likert scale to measure product suitability through a questionnaire. Qualitative data was obtained from the assessment of the validation sheet in the experts' reviews of the product. Quantitative data was obtained through experts' assessment of the validation sheet. The expert validation sheet used to test product suitability uses a Likert scale as a reference in the questionnaire. The Likert scale is a measure-ment tool used in feasibility testing to determine the attitudes and opinions of individuals or groups towards products through questionnaires. The Likert scale can be seen in Table 1 below.

**Table 1.** Likert scale criteria.

| Score | Criteria |
|---|---|
| 1 | Strongly Disagree/ Poor |
| 2 | Disagree/ Poor |
| 3 | Agree/ Good |
| 4 | Strongly Agree/ Very good |

Source: Haking & Soepriyanto (2019)

Based on the table listed, it is explained that a score of 1 indicates that the prod-uct criteria are not worthy to implement. In contrast, a score of 4 indicates that the criteria are worthy to implement. In addition, the scores given by media ex-perts and material experts will be calculated using the Likert scale formula as follows:

$$\text{Score} = \frac{score\ obtained}{maximum\ score} \text{ x } 100\% \text{ (Hidayat \& Irawan, 2017)}$$

After getting the percentage score, the results can be interpreted in terms of scale criteria, as in Table 2 below.

**Table 2.** Scale interpretation criteria

| Score | Criteria |
|---|---|
| 75% ≤ x ≤ 100% | Very worthy |
| 50%≤ x < 75% | Worthy |
| 25%≤ x < 50% | Less Worthy |
| 0%≤ x < 25% | Not worthy |

Source: Aulia et al. (2022)

Table 2 is used as a reference to see the percentage and level of feasibility of media trials. If the product gets a percentage result ≤ 25%, it is declared unworthy to use, while if the percentage obtained ≥ 76%, it is declared very worthy.

## Research Results and Discussion

### *Media Development Board Game Jejak Alam Pranata Mangsa (JALPAMA)*

This learning media development uses the Analyze, Design, Development, Imple-mentation, Evaluation (ADDIE) design model. This study aims to develop learn-ing media in the form of board games using the ADDIE model from the analysis stage, design stage to the development stage because the purpose of this study is only to develop and produce valid learning media based on validator assessments which are then implemented to elementary school students to optimize science literacy. The developed board game media aims to help students understand IPAS learning contextually based on the ethnoscience of the prefecture, which is ex-pected to increase interest in learning and optimize science literacy skills.

The initial stage of the ADDIE media development model is analysis. The de-velopment of this media is based on the analysis of needs and phenomena in el-ementary schools in Surakarta. The results of interviews and questionnaires show that students still need to maximize science literacy and innovative learning me-dia in learning IPAS. Students are less enthusiastic about learning IPAS due to limited time and innovative learning media facilities, so teachers need help de-veloping fun and contextual learning. The IPAS material requires a scientific approach that is contextual and experimental, so students must think critically and participate actively. Teachers sometimes still need to work on providing ap-propriate methods and media for students to think critically and actively partici-pate. Teachers also mentioned that no learning media supports the achievement of IPAS learning in the learning outcomes of the Merdeka curriculum in 2024. According to the results of the needs analysis, students and teachers are interest-ed in using concrete learning media, such as board game media, by applying local wisdom to it. After analyzing these needs and problems, the researcher proposed a solution in the form of using innovative concrete media integrated with an eth-noscience approach in the form of local wisdom in the form of Pranata Mangsa, which is expected to be able to help teachers teach, increase student learning motivation, optimize science literacy, and introduce local wisdom related to IPAS learning. The local wisdom approach of Pranata Mangsa applied in the board game media is related to one of the student learning outcomes in phase B of the Natural and Social Sciences (IPAS) element of understanding IPAS based on the Decree of the Ministry of Education and Culture Number 032/H/Kr/2024, which is expected that after learning students can explain and solve problems related to the preservation of natural resources as an effort to mitigate climate change. Pranata Mangsa, as a determination of seasonal changes, is closely related to preserving renewable natural resources in agriculture and as a marker of seasonal changes.

After analyzing the problems in the field, the researcher designed and devel-oped the media by making a storyboard about the board game Jejak Alam Prana-ta Mangsa (JALPAMA) based on the ethnoscience of Pranata Mangsa. The me-dia was

developed based on the storyboard and tested by media and material experts. The storyboard describes the design, materials, images, and instructions for use and helps visualize the game's flow. The storyboard of the JALPAMA board game learning media is presented in Table 3 below:

**Table 3.** Storyboard board game JALPAMA

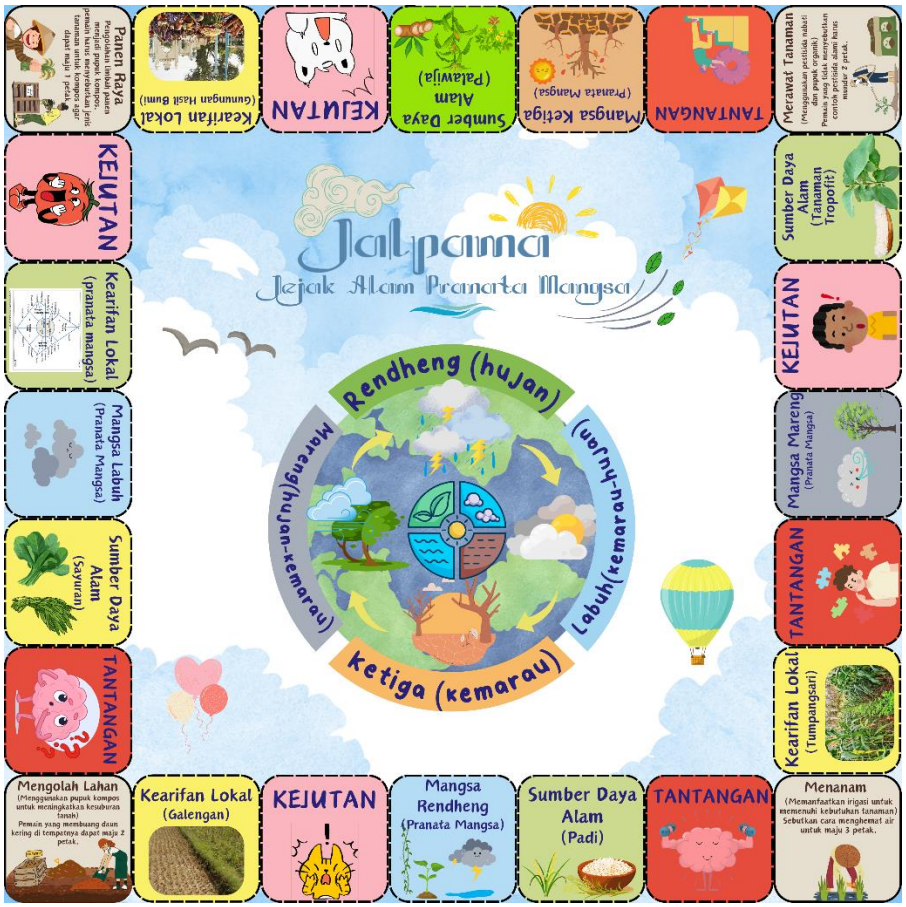
| No. | Aspects | Informations | Utilities |
|---|---|---|---|
| 1 | Board Game | The name of the game.<br>Each side contains information (agricultural stages, local wisdom, natural resources, local wisdom, surprises, challenges, seasons in the prefecture) and illustrations/pictures. | The game focuses on collecting points in 10-15 minutes.<br>When a player has rolled the dice and is standing on one of the plots, the player must take one card corresponding to the name of the plot. |
| 2 | *Pranata Mangsa* card | Illustration of each season.<br>The card contains seasonal material on the *Pranata Mangsa* calendar, which is divided into four seasons, namely the rainy season (*rendheng*), the transition season from rain to dry (*mareng*), the dry season (*ketiga*), and the transition season from dry to rain (*labuh*). | Players need to read the information on the prey system card to earn 15 points. |
| 3 | Natural resources card (*Kartu sumber daya alam*) | Illustration of nature.<br>The cards contain material about renewable natural resources worthy for planting each season. | Players need to read the information on the natural resources card to earn 5 points. |
| 4 | Local wisdom card (*Kartu kearifan lokal*) | Illustrations related to local wisdom and nature.<br>The card contains local wisdom in Surakarta related to agriculture and preserving natural resources as climate change mitigation. | Players need to read the information on the local wisdom card to earn 5 points. |
| 5 | Surprise card (*Kartu kejutan*) | Illustrations contain pictures and sentences about natural disasters<br>Surprise cards contain various natural disasters due to climate change and their mitigation that can harm or benefit players. | Players must perform the commands on the surprise card. |
| 6 | Challenge card (*Kartu tantangan*) | Illustrations contain pictures and questions about the impacts of climate change.<br>Challenge cards contain questions | Players need to read and answer questions to earn 15 points. |

| | | | |
|---|---|---|---|
| | | about the impacts of climate change. | |
| 7 | Dice | A cube with six sides, each with a point indicating the number of steps for the player's pawn. | Players need to roll the dice according to their turn. |
| 8 | Pawn | There are four pawns of different colours. | Players may only choose one pawn. |
| 9 | Game instructions | The instruction sheet contains similar illustrations on the board game with instructions on how to use the board game media. | The instruction sheet contains similar illustrations of the board game and instructions on using the board game media. |

The Jejak Alam Pranata Mangsa (JALPAMA) board game media includes an explanation of the various seasons according to Pranata Mangsa, natural re-sources for each season, stages of environmentally friendly agriculture, local wisdom related to agriculture in Surakarta, as well as information and questions about the impact of climate change. This material is adapted based on IPAS phase B learning outcomes. The development of this media considers the needs of students and teachers and aspects that are attractive to students, such as font types, colours, illustrations, and game systematics that are easy to understand according to the storyboard design. The appearance of the stage 1 board game before being reviewed and revised is presented in Figure 1 below.

1c

1d




1a

1b

Translation:
Center of the board game

1. JALPAMA (Pranata Mangsa Nature Trail)
2. Rendheng (rainy season)
3. Labuh (dry-rainy season)

4. Ketiga (dry season)
5. Mareng (rainy-dry season)

1a (from right to left)
1. Cultivate the land (use compost fertiliser to increase soil fertility): Players who have discarded the dried leaves in place can advance 2 plots
2. Local wisdom: Galengan (land boundaries in rice fields)
3. Surprise
4. Mangsa rendheng (rainy season) : Pranata Mangsa (local wisdom in Indonesia)
5. Natural resources: rice
6. Challenge

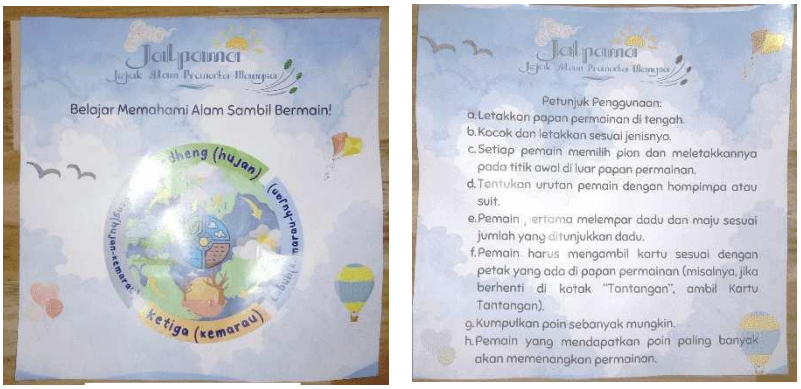
1b (from bottom to top)
1. Planting (utilizing irrigation to meet the needs of plants): Mention how to save water in order to advance 3 plots
2. Local wisdom: Tumpangsari (planting two or more crops simultaneously on the same land)
3. Challenge
4. Mangsa Mareng (rainy to dry transition season) : Pranata Mangsa (local wisdom in Indonesia)
5. Surprise
6. Natural resources: tropophytic plants

1c (from left to right)
1. Caring for plants (using plant-based pesticides and organic fertilizers) : Players who cannot name examples of natural pesticides must retreat 2 plots.
2. Challenge
3. Mangsa Ketiga (Dry season): Pranata Mangsa (local wisdom in Indone-sia)
4. Natural resources: Palawija (such as corn, soybeans, and peanuts)
5. Surprise
6. Local Wisdom: Gunungan Earth Products (a pile or collection of harvest-ed agricultural and garden products)

1d (from top to bottom)
1. Great Harvest (processing harvest waste into compost): players must men-tion the type of crop to be composted in order to advance 1 plot.
2. Surprise
3. Local Wisdom: Pranata Mangsa
4. Mangsa Labuh (dry to rainy season): Pranata Mangsa (local wisdom in Indonesia)
5. Natural resources: vegetables
6. Challenge

**Figure 1.** Stage 1 JALPAMA board game media display

JALPAMA board game media based on ethnoscience Pranata Mangsa is a concrete learning media that includes seasonal and weather material related to natural resource conservation as climate change mitigation. The researcher used the Canva application to design the media, user guide, and companion card. The game board design was then downloaded in PDF format and printed on 100 cm x 100 cm MMT to enhance usability and strengthen durability. The user guide was printed on art paper, size 20.5 cm x 20.5 cm. Figure 2 below shows the instruc-tions for stage 1 before review and revision.




(a) Front side (b) Back side

Translation:
2a (from front side)
1. JALPAMA (Pranata Mangsa Nature Trail)

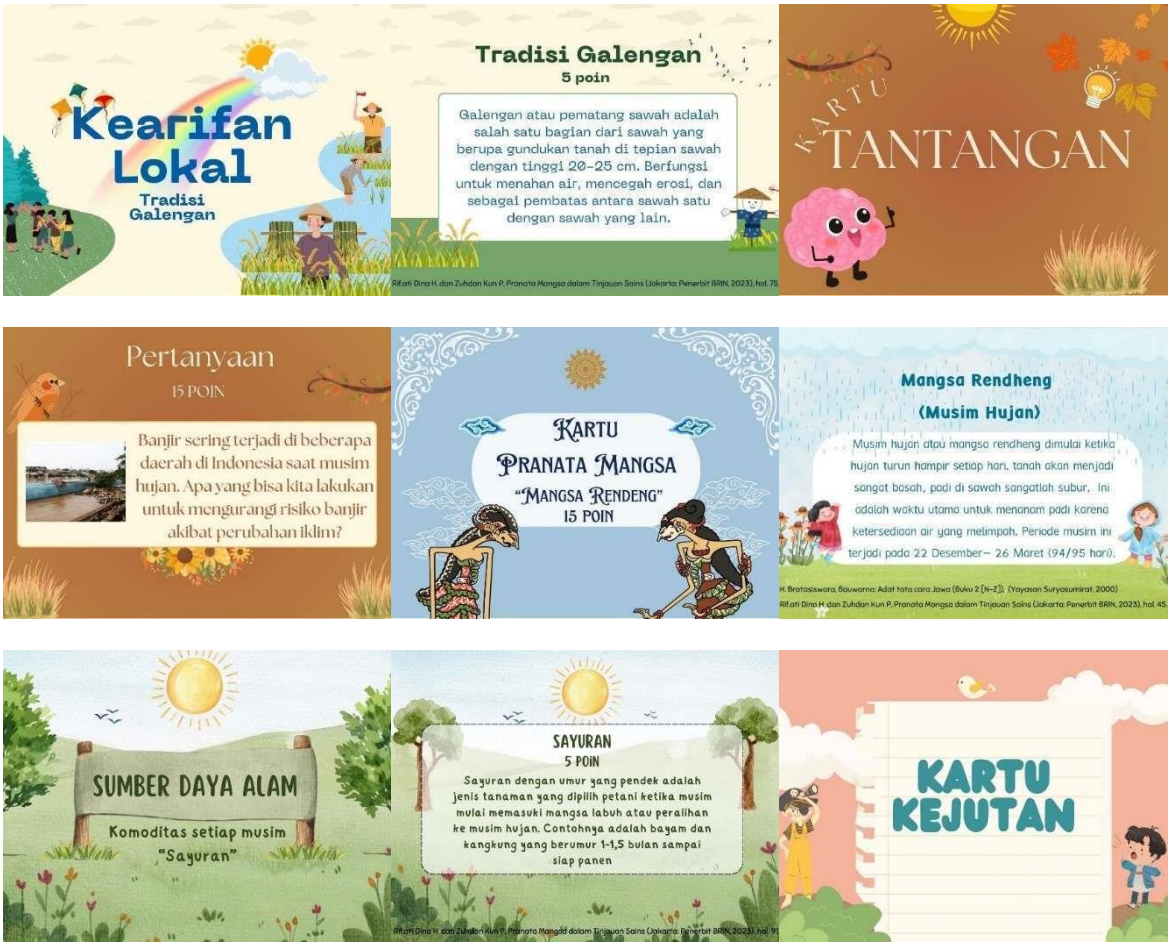
2. Rendheng (rainy season)
3. Labuh (dry-rainy season)
4. Ketiga (dry season)
5. Mareng (rainy-dry season)

2b (from back side)

1. JALPAMA (Pranata Mangsa Nature Trail)
2. Instructions for use
3. Place the game board in the center
4. Shake and place according to type
5. Each player chooses a pawn and places it on the starting point outside the game board.
6. Determine the order of players by “hompimpa” or “suit”.
7. The first player rolls the dice and advances according to the number indicated by the dice.
8. Players must pick up the card corresponding to the square on the game board (for example, if they stop at the "challenge" square, pick up the challenge card).
9. Collect as many points as possible
10. The player who gets the most points wins the game

**Figure 2.** Stage 1 Instructions for use display

Furthermore, the companion card is printed in an alternating format, with a size of 10 cm x 7.5 cm, using art carton paper. The IPAS learning process using JALPAMA media will include all media tools presented to increase student en-thusiasm and make it easier for students to receive IPAS material so that it is ex-pected to optimize student science literacy. The following displays the cards ac-companying the JALPAMA board game media stage 1 presented in Figure 3.



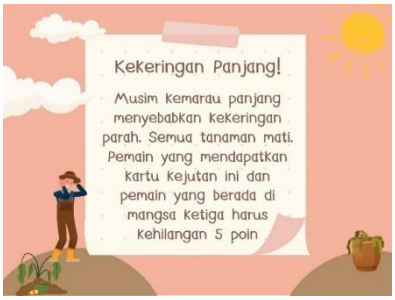



**Figure 3.** Stage 1 Display of the JALPAMA board game companion cards

In addition to instructions for use and companion cards, the Jejak Alam Prana-ta Mangsa (JALPAMA) board game is equipped with pawns, dice, and instruc-tions for use and companion cards. There are four pawns in this media with vari-ous bright colours that attract attention. Each pawn is made of wood and is 16 cm x 6 cm. Dice also uses different colours on each side. The dice size is 9 cm x 9 cm x 9 cm with art carton material. The dice and pawns are purchased separately at different stores. The following is a display of the pawns and dice used. The ap-pearance of the other equipment of the board game in the form of dice and pawns is shown in Figure 4.

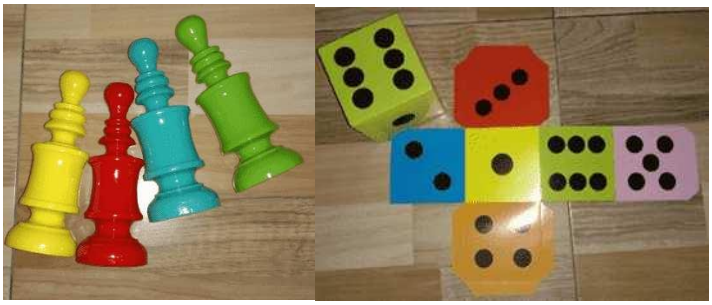


**Figure 4.** Display of board game equipment

The following is the display of all devices in the JALPAMA ethnoscience-based pre-natal board game media shown in Figure 5.

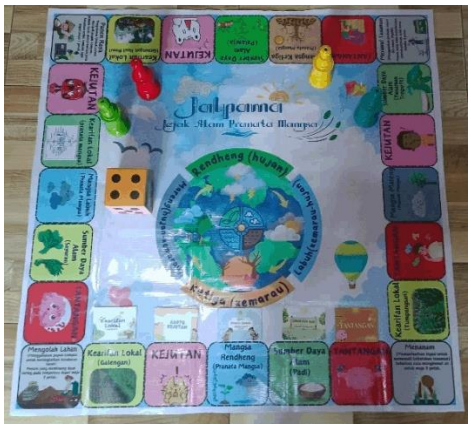



**Figure 5.** Stage 1 Complete device display of Jejak Alam Pranata Mangsa (JALPAMA) board game

The Jejak Alam Pranata Mangsa (JALPAMA) board game media has been adapted to the needs and phenomena in elementary schools. This media has vari-ous components such as game board media that can increase students' enthusiasm for learning, then with companion cards, especially those information cards that are expected to be able to introduce local wisdom in Surakarta, namely Pranata Mangsa, introduce renewable natural resources, and introduce local wisdom around students, as well as challenge cards that contain various questions about the impact of climate change so that students can hone their critical thinking skills based on science on issues around students which hopefully can be an al-ternative in optimizing science literacy.

### *Media Validation Results of Jejak Alam Pranata Mangsa (JALPAMA) Board Game*

After the researchers succeeded in developing the design of the learning media board game Jejak Alam Pranata Mangsa (JALPAMA) based on ethnoscience Pranata Mangsa, the next step is to test the board game to find out how feasible this

media is used. Media and material experts tested the JALPAMA board game media according to their validation sheets. MAs conducted media trials with ex-pertise in learning media. The validation questionnaire sheet provided by the researcher contains 25 questions regarding the suitability of the media, which includes aspects of content, grammar, language, and media presentation, with a score scale of 1-4. AD carried out material expert validation of JALPAMA board game media products with scientific experts in science learning. The validation questionnaire provided contains 20 questions containing aspects of the content of the material, the language of the material, and the feasibility of presenting the material on the media. The results of the media expert test are shown in Table 4 below.

**Table 4.** Media expert test results

| No | Rated aspect | Score obtained | Maximum Score | Percentage | Information |
|---|---|---|---|---|---|
| 1 | Linguistic aspect | 16 | 16 | 100% | Very worthy |
| 2 | Graphical aspect | 38 | 44 | 86,3% | Very worthy |
| 3 | Media Content aspect | 28 | 28 | 100% | Very worthy |
| 4 | Media Presentation aspect | 12 | 12 | 100% | Very worthy |

The results of the media expert test in Table 4 show that the JALPAMA (Jejak Alam Pranata Mangsa) board game media obtained an average score of 91% (very feasible) and was declared valid without revision. The linguistic aspect (typography) and media content (relationship with the material) obtained 100% feasibility. Graphic aspects (design, color, pictures/illustrations, layout) obtained 86.3% feasibility. The presentation aspect (ease of use instructions, suitability for student development, and characteristics) also received 100% feasibility. Media experts suggest adding instructions on the starting order of the game to make it more understandable and accessible for elementary school students. Af-ter conducting a media feasibility test with media experts, the JALPAMA (Jejak Alam Pranata Mangsa) board game media must conduct a material validation test with experts with science learning expertise. The validation test sheet will in-clude several aspects, namely content suitability, language, and presentation fea-sibility. The results of the material expert validation are presented in Table 5 below.

**Table 5.** Material expert test results

| No | Rated aspect | Score obtained | Maximum Score | Percentage | Information |
|---|---|---|---|---|---|
| 1 | Content aspect | 30 | 32 | 93,75% | Very worthy |
| 2 | Linguistic aspect | 27 | 28 | 96,42% | Very worthy |
| 3 | Presentation aspect | 20 | 20 | 100% | Very worthy |

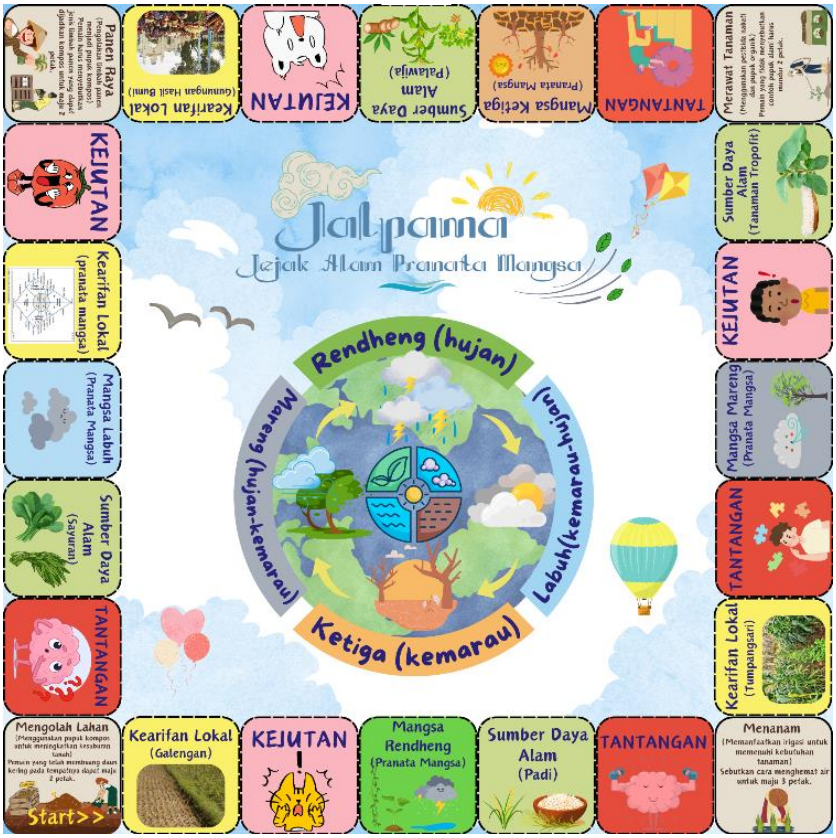
The results of the material expert test in Table 5 show that the JALPAMA (Jejak Alam Pranata Mangsa) board game media obtained a score of 96.25% (very fea-sible) and was declared valid with revisions. Aspects of material content, such as the suitability of learning outcomes, the truth of the material, and science literacy skills, obtained 93.75% eligibility. The linguistic aspects include language effec-tiveness and suitability for student understanding. The material expert gave notes to add more precise points on how to play. The presentation includes orderliness, comprehensibility, and interactivity, with suggestions to improve the instructions for use, add explanations of card types, a 'start' sign on the game board, and in-structions for returning cards. Overall, this media is very feasible to use.

Media and material specialists have performed evaluations following their specific validation criteria. The assessment by media specialists included 25 questions concerning the media's suitability, addressing elements like content, grammar, language, and presentation, rated on a scale from 1 to 4. The validation process by material experts included 20 questions regarding the content, lan-guage, and presentation practicality. The outcomes from the media expert evalua-tion resulted in an average score of 91% (highly feasible), concluding that the media was valid without needing revisions. Media experts suggested adding guidance for the game sequence in the usage instructions. The validation assess-ment by science education experts yielded a score of 96.25% (highly feasible), concluding that the media was valid. However, revisions were needed, such as clarifying how to play and explaining the card types. In summary, this media was deemed highly feasible for use.

### *Improvement Stage of Media Board Game Jejak Alam Pranata Mangsa (JALPAMA)*

After going through the validation test stage, researchers reviewed the learning media that had been made and improved the JALPAMA board game media based on the results of the reviews given by the experts. The following is a display of the JALPAMA (Jejak Alam Pranata Mangsa) stage 2 ethnoscience-based board game media that has gone through the revision stage shown in Figure 6.

6b




6d 6b

6a

Translation:

6a (from right to left)

1. Cultivate the land (use compost fertiliser to increase soil fertility): Players who have discarded the dried leaves in place can advance 2 plots
2. Local wisdom: Galengan (land boundaries in rice fields)
3. Surprise
4. Mangsa rendheng (rainy season): Pranata Mangsa (local wisdom in Indonesia)
5. Natural resources: rice
6. Challenge

6b (from bottom to top)

1. Planting (utilizing irrigation to meet the needs of plants): Mention how to save water in order to advance 3 plots
2. Local wisdom: Tumpangsari (planting two or more crops simultaneously on the same land)
3. Challenge
4. Mangsa Mareng (rainy to dry transition season): Pranata Mangsa (local wisdom in Indonesia)
5. Surprise
6. Natural resources: tropophytic plants

6c (from left to right)

1. Caring for plants (using plant-based pesticides and organic fertilizers) : Players who cannot name examples of natural pesticides must retreat 2 plots.
2. Challenge
3. Mangsa Ketiga (Dry season): Pranata Mangsa (local wisdom in Indone-sia)
4. Natural resources: Palawija (such as corn, soybeans, and peanuts)
5. Surprise
6. Local Wisdom: Gunungan Earth Products (a pile or collection of harvest-ed agricultural and garden products)

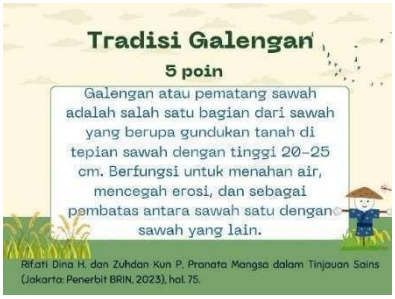
6d (from top to bottom)

1. Great Harvest (processing harvest waste into compost): players must men-tion the type of crop to be composted in order to advance 1 plot.
2. Surprise
3. Local Wisdom: Pranata Mangsa
4. Mangsa Labuh (dry to rainy season): Pranata Mangsa (local wisdom in Indonesia)

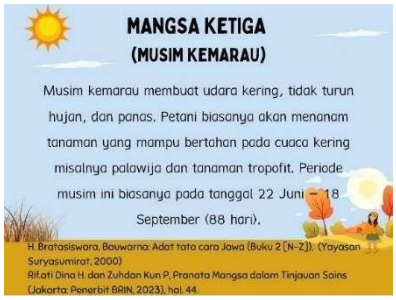
5. Natural resources: vegetables
6. Challenge

**Figure 6.** Stage 2 Display of board game JALPAMA

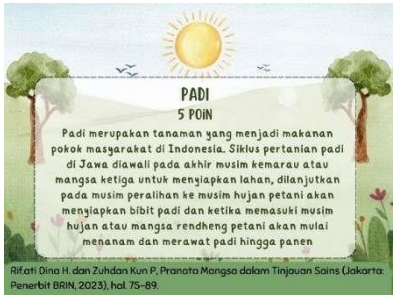
The ethnoscience-based board game Jejak Alam Pranata Mangsa (JALPAMA) underwent improvements based on feedback from media and material experts. Researchers added a clear 'start' sign at the beginning, marking the game's initiation on the 'cultivating land' plot, representing the agricultural cycle's first stage. They refined the writing, colors, and layout of the board game. Experts enhanced the companion cards by providing more precise information and references, es-pecially regarding local wisdom, natural resources, and prefiguration cards. The researchers focused on ensuring that the companion cards only displayed essen-tial information on the back. The revised stage 2 companion card is illustrated in Figure 7 below.




(a) Local Wisdom Card (*Kartu Kearifan Lokal*)




(b) *Pranata Mangsa* Card




(c) Natural Resources Card (*Kartu Sumber Daya Alam*)

**Figure 7.** Stage 2 Display of companion card

Translation:

a) Galengan or pematang sawah is one part of the rice field in the form of a mound of tanah on the edge of the rice field with a height of 20-25 cm. It functions to retain water, prevent erosion, and as a barrier between one rice fieldand another.
   Footnotes: Rifati Dina H and Zuhdan Kun P. Pranata Mangsa in science review (Jakarta: BRIN Publisher, 2023), p.75
b) Mangsa Ketiga (dry season)
   The dry season makes the air dry, there is no rain, and the weather is hot. Farmers will usually plant crops that are able to withstand dry weather, such ascropsand tropical plantsofit. The season period is usually from June 22 to September 18 (88 days).
   Footnotes:
   H. Bratasiswara, Bauwarna: Javanese Customs and Procedures (Book 2 [N-Z]). (Suryasumirat Foundation, 2000)
   Rifati Dina H and Zuhdan Kun P. Pranata Mangsa in science review (Jakarta: BRIN Publisher, 2023), p.447c
c) Rice
   Rice is a crop that is the staple food for people in Indonesia. The rice farming cycle in Java begins at the end of the dry season or mangsa keti-ga to prepare the land, followed by the transition to the rainy season, farmers will then prepare rice seeds and when entering the rainy season or mangsa rendheng, farmers will start planting and nurturing until harvest.
   Footnotes: Rifati Dina H and Zuhdan Kun P. Pranata Mangsa in science review (Jakarta: BRIN Publisher, 2023), p.75-89

Researchers improved the arrangement of instructions for the JALPAMA board game, making it easier for elementary school students to play coherently and understand quickly. Figure 8 shows a view of the stage 2 instructions for use that have gone through the improvement process

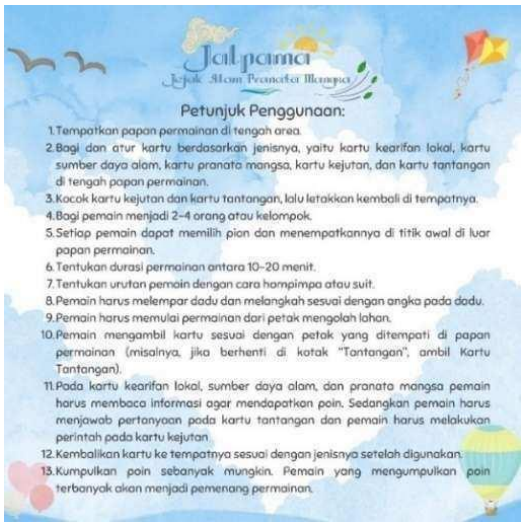



**Figure 8.** Stage 2 Display of companion card

Translation:
1. JALPAMA (Pranata MangsaNature Trail )
2. Instructions for use
3. Place the game board in the center of the area
4. Divide and organize the cards based on their type, i.e. local wisdom cards, natural resource cards, prefecture cards, surprise cards, and challenge cards in the center of the game board.
5. Shuffle the surprise cards and challenge cards, then put them back in place
6. Divide players into 2-4 people or groups
7. Each player can choose a pawn and place it at the starting point out-side the game board
8. Each player can choose a pawn and place it at the starting point out-side the game board
9. Determine the order of players by hompimpa or suit
10. Players must roll the dadau and step according to the number on the dice
11. Players must start the game from the land plot
12. Players pick up cards according to the square they occupy on the game board (e.g. if stopped on the "Challenge" square, pick up a Challenge card).
13. Players pick up cards according to the square they occupy on the game board (e.g. if stopped on the "Challenge" square, pick up a Challenge card).
14. Return the battery to its place according to its type after use.
15. Collect as many points as possible. The player who collects the most points will be the winner of the game.

After experts provide their feedback, the researchers hope to implement the JALPAMA board game in elementary schools to help enhance students' science literacy skills.

## *Disscussion*

### *Media Development of Jejak Alam Pranata Mangsa (JALPAMA) Board Game*

Learning media in the form of board games can be one of the innovations that can make the learning process more exciting and interactive and improve science literacy (H. Handayani et al., 2019; H. Handayani & Somantri, 2023; S Karo-Karo & Rohani, 2018). The Jejak Alam Pranata Mangsa (JALPAMA) board game is one of the learning media innovations that aims to optimize the science literacy of elementary school students. Similar previous research has developed board game media based on the PISA framework, which proved effective in improving students' science literacy (Kencana et al., 2018). This game addresses the needs of students and teachers for effective learning media in implementing IPAS learning, aiming to enhance science literacy. The importance of science literacy in Revolution 4.0 makes educators advised to use various media and varied learning models, one of which uses ethnoscience-based learning (Pertiwi & Rusyda Firdausi, 2019; Sibarani et al., 2019). Teachers can use the development of JALPAMA board game media to integrate various media

and models that they can adjust to meet the needs and challenges faced by students. JALPAMA board game media integrates an ethnoscience approach to facilitate the identification of issues in everyday life and integrate culture into scientific knowledge (Y. Wahyu, 2017). JALPAMA board game media can be an alternative learning media that supports student understanding and helps teachers deliver IPAS learning materi-als by the IPAS learning outcomes for elementary schools based on the Decree of the Ministry of Education and Culture Number 032/H/Kr/2024 concerning Learn-ing Outcomes. JALPAMA media contains IPAS phase B learning about natural resource conservation as climate change mitigation (Kemendikbudristek, 2024).The ethnoscience approach associated with the material uses one of the local wisdom in Surakarta, namely Pranata Mangsa. Pranata Mangsa is a cultural science-based local wisdom that guides the peri-odization of time for one year based on the sun's circulation. Pranata Mangsa guides agricultural activities and prepares farmers for seasonal changes (R. D. Handayani et al., 2023). The Jejak Alam Pranata Mangsa (JALPAMA) board game includes an explanation of the various seasons according to Pranata Mang-sa, natural resources in each season, the stages of environmentally friendly agri-culture, local agricultural wisdom in Surakarta, as well as information and ques-tions about the impact of climate change. The development of this JALPAMA board game media aims to optimize students' science literacy by providing a fun learning atmosphere and encouraging students to actively participate in each other so that students are more motivated and able to hone their science literacy skills and get to know the local wisdom of Pranata Mangsa. The benefits of im-plementing learning media in the form of board games are honing the ability of real social interaction and educating students so that it is considered interactive (Limantara, D. et al., 2015).

### *Results of Validation of Media Development Board Game Jejak Alam Pranata Mangsa (JALPAMA)*

Researchers validated with experts with their respective fields of expertise per the Jejak Alam Pranata Mangsa (JALPAMA) media. As Ihsan (2015) stated, val-idation is a process to ensure that the test measures what should be measured. In this study, there are two types of validation tests, namely material and media validation tests. Based on the media validation test by experts who have scien-tific experts in the form of learning media, the average score is 91%, with the conclusion that JALPAMA media is valid without revision. The media validation test instrument contains four aspects: language, graphical, content, and presenta-tion. Sari (2018) explains that in the linguistic aspect, the media needs to use the correct language and be easy to understand; this is very important to help stu-dents understand the material better; good graphic design can help increase at-tractiveness and make it easy to read, the content of the material in the media must be complete, in-depth, and by the applicable curriculum, and the presenta-tion of the media must be presented in an exciting and easy to understand way for students. The instrument used to test the validation of the JALPAMA board game media aligns with these aspects.

Based on the data from the media validation test results shown in Table 4, al-most all aspects received perfect scores, except for the graphic aspect, which obtained a percentage score of 86.3%. The graphical aspects include several ele-ments, such as design, color, images or illustrations, and layout. However, in the JALPAMA board game media, there are still less than perfect scores in the graph-ical aspects, especially the layout section, which gets an average score of 3.25 out of 4.00. Manshur & Rodhi (2020) state that graphic media is vital in learning because it can attract students' attention, clarify the ideas conveyed, and illus-trate facts to spur learning motivation and student understanding. The graphic aspects of JALPAMA media, with a percentage score of 86.3%, require improve-ment in the graphics aspects to maximize the results of the JALPAMA board game media design so that it can clarify the material and attract students' atten-tion to spur learning motivation. Although there are still imperfections, the aver-age that shows the feasibility and validity of the JALPAMA board game media, especially in the aspects of media content and presentation, shows that the con-tent of the entire media has been recognized as suitable for implementation, as has the presentation of this board game media game, which is declared suitable for use by elementary school students.

Meanwhile, according to the results of material validation by experts with sci-ence learning experts, the average percentage score is 96.25%, with the conclu-sion that the media is valid with some revisions. Based on the material validity test instrument on the JALPAMA board game media, several aspects are as-sessed: content feasibility, presentation feasibility, and linguistic aspects. Ac-cording to Table 5, which contains the results of each aspect, it can be seen that the presentation aspect has received a perfect score, indicating that the presenta-tion of the material in the JALPAMA media has received high feasibility. Howev-er, the content aspect of the material only scored 93.75%, with some imperfec-tions in the suitability of the content with information and the development of students' science attitudes. The JALPAMA board game serves as an IPAS learning support media focusing on understanding natural resource conservation for cli-mate change mitigation. It customizes the material to align with the topics dis-cussed. Given the importance of material and the learning process in education, learning support must adjust to the concept of material in the subject content (Maksum & Juwita, 2016). This aims to make learning supports such as media and the learning process more effective in achieving maximum learning goals and supporting teachers in the learning process (Habudin & Nova, 2017). In addition, the JALPAMA board game media needs to develop students' scientific attitudes in the learning process further. Science literacy is the ability to apply scientific processes and scientific attitudes to the real environment (Ratnasari, 2019).

The linguistic aspect received a score of 96.42%, with the communicative use of language being less than perfect due to incomplete user instructions. In the JALPAMA board game learning media, it is necessary to improve the linguistic aspects because using good and correct language can support students' needs in absorbing information and material to

facilitate student understanding (Apriliana, 2017). The material expert provided some input, namely that the JALPAMA board game media needs to add a 'start' sign at the beginning to make it easier for students to understand the material and then add some instructions for use need to make it more communicative and transparent, improve the cards to enlarge the references. Researchers have improved the media by the input, which hopes to maximize the function of this media. According to Ningtyas & Rahmawati (2023), the feasibility of the material's content, presentation, and language in the media is fundamental to ensure that the material presented is by the curriculum and easy to understand by students. The JALPAMA board game media adapts its material to meet the learning outcomes of IPAS in the Merdeka curriculum, making it suitable for elementary school students.

The average validation from media and material experts shows 93.62%, indi-cating that JALPAMA ethnoscience-based learning media is feasible. With some improvements, this media can be better and more valuable. This JALPAMA board game media is an innovation of new creativity developed by utilizing an ethno-science approach in the local wisdom of the prefecture based on the latest IPAS phase B learning outcomes. The JALPAMA board game media helps make abstract concepts tangible and optimizes science literacy by integrating ethnosci-ence-based contextual learning of Pranata Mangsa. The research conducted by H. Handayani & Somantri (2023) proves that board game media effectively im-proves science literacy, forming the foundation for developing JALPAMA board game media. Learning media has various benefits, such as making abstract con-cepts actual, creating a fun learning atmosphere, and overcoming time constraints (Handhita et al., 2016). The JALPAMA board game media can emphasize inte-grated understanding, connecting material with the context of everyday life and science and technology (Harefa, 2017). This project is on the concept of science literacy by Syofyan & Amir (2019), namely the ability of science literacy to ap-ply scientific knowledge in everyday life. Development with JALPAMA board game media based on ethnoscience of pre-natal order is expected to be imple-mented and able to optimize students' science literacy at the elementary school level.

## Conclusion

According to the results of this study, it can be concluded that the product devel-oped in this study is in the form of JALPAMA (Jejak Alam Pranata Mangsa) board game media based on ethnoscience Pranata Mangsa, an educational game board. The material presented in this media is the material of natural resource conservation as an effort to mitigate climate change in phase B Natural and So-cial Sciences subjects in elementary schools. JALPAMA board game media prod-ucts based on ethnoscience Pranata Mangsa obtained feasibility from media and material experts' validation tests. The results of the media feasibility test showed a percentage of 91%, so the JALPAMA board game media product had "very wor-thy" criteria, and the results of the material feasibility test showed a percentage of 96.25%, which also had "very worthy" criteria. The JALPAMA board game media can be even better by implementing improvements according to expert input. The following research recommendation is to implement the JALPAMA board game media in elementary school students to determine the level of media optimization on science literacy.

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